ERIC Document Resume | See Instruction Sheet | DATE OF RESUME | DATE RECEIVED

A. PUBLICATION DATA

1. ERIC NUMBER: ED002171
2. ORIGINATOR CONTROL NO(S).: NA
3. IDENTIFICATION NO.: 1121

DO NOT WRITE IN SPACE BELOW

4. AUTHOR(S): Melaragno, Ralph J.

5. TITLE OF DOCUMENT ABSTRACTED: Results of Experiment on Negative Reinforcement in Automated Teaching

6. PUBLICATION TITLE: NA

7. EDITOR(S): NA

8. PLACE OF ORIGIN: System Development
ORG. Corporation
ST.
CITY, STATE: Santa Monica, Calif.
TELE. EXT.
INST/LOC CODE

9. PUBLISHER OR SOURCE: System Development Corporation
Santa Monica, California

10. VOL.	11. PAGES	12. MO./YR.	13. TOTAL PP.
NA	NA	Apr 60	11

MICROFILM COPY AVAILABLE: YES [X] NO [ ]

COPYRIGHT GRANTED: YES [ ] NO [X]

COPYRIGHT RELEASE FILED: YES [ ] NO [ ]

TYPE OF REPORT
PROPOSAL [ ]
IN-PROGRESS [ ]
FINAL [X]
FOLLOW-UP [ ]

OTHER ERIC REFERENCES:

ERIC SATELLITE CODE

B. INDEXING DATA

14. SUBJECT AREA

15. TYPE OF ENDEAVOR: report

16. INDEXING TERMS (6-12)

automated teaching	negative reinforcement	reinforcement		
programed learning	massed negative	reinforcement	instructional technology	
teaching machines	positive reinforcement			

17. ABSTRACT (MAX. 250 WORDS)

An experiment to compare spaced negative reinforcement, massed negative reinforcement, and positive reinforcement in automated teaching is described.

Three groups of college freshmen were used in the study. Each group was given instructional material containing ambiguous information interspersed among meaningful information. One group received a "correct" signal regardless of the response made; another group received some incorrect signals; and the third group received a series of "incorrect" signals. A criterion test was given to the three groups. Test results were evaluated.

The students who received no or few negative responses learned more than those who received many negative responses. Some negative signals may be beneficial to the learning process. Too many negative signals had an adverse effect upon the learner. Implications for teaching machine design and bibliography are included.

ERIC No.

18. SOURCE OF ABSTRACT

C. FUNDING DATA

19. SUPPORTING ORGANIZATION

20. DIVISION OR DEPT.

21. CONTRACT NO.

PROJECT NO.

22. TOTAL COST OF PROJECT

23. DURATION OF PROJECT

U.S. Department of Health, Education, and Welfare
Office of Education

ED002171

1121

REPRINT

SP-169 Ralph J. Melaragno

RESULTS OF EXPERIMENT ON NEGATIVE REINFORCEMENT IN AUTOMATED TEACHING

25 April 1960

SYSTEM DEVELOPMENT CORPORATION, SANTA MONICA, CALIFORNIA

REPRINTED BY PERMISSION
U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN PRINTED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

J0252

ABSTRACT

An experiment to compare spaced negative reinforcement, massed negative reinforcement and positive reinforcement in automated teaching is described. Conclusions and implications for teaching machine design are included.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the assistance of the following people in the preparation and execution of this study: Morio Asato, John Coulson, Don Estavan, Gene Jones, Jim Sheldon and Harry Silberman.

RESULTS OF EXPERIMENT ON NEGATIVE REINFORCEMENT IN AUTOMATED TEACHING

Various studies of knowledge of performance (Ammons, 1956; MacPherson, Dees, & Grindley, 1948-9; Osgood, 1953) have shown that a subject will improve in his performance when he is given knowledge of results. In their survey of the factors in learning efficiency, moreover, Gagne & Rolles (1959) point to experimental evidence indicating that reinforcement should be positive rather than negative, constructive rather than destructive.

Much of contemporary teaching machine design has been derived from the systematic position advanced by Skinner (1954, 1958), who holds that the teaching sequence should be organized to maximize successes and minimize failures; that is, should contain maximum positive reinforcement and minimum negative reinforcement. Items in the teaching sequence are to be so written and assembled that the step between items is small, and each item will be relatively easy to answer. Then, the teaching sequence for a given body of material will necessitate a lengthy series of simple questions, to be seen sequentially by all students. Ideally, every student will go through the sequence with as few errors as can possibly be arranged; with no errors, if such a teaching sequence can be developed.

Another position on teaching machine design (Coulson, 1959) is that the machine should be flexible enough to adjust itself to every student's unique ability to learn a subject. Such a design utilizes a varying number of items

and varying sequences of items. Each student will go through a teaching session seeing a sequence that best fits his ability. The student will see additional items when his errors indicate his inability to grasp a point or a concept. He then will be shown easier items, on the same concept, that are intended to help him over the hurdle he has just met. A student who meets no hurdles will skip past redundant items.

The latter design locates a student's difficulty on the basis of his errors. Such a design will, perforce, have built into it some (unknown) number of failures that will be accompanied by negative reinforcement. It is assumed that the simple presence of some negative reinforcement will not be detrimental to a student's learning.

The present study was designed to test the hypothesis that some negative reinforcement appearing within a sequence of instructional items, all of which are positively reinforcing, will not depress a student's learning of the subject matter.

METHOD

Subjects

Twenty-eight paid volunteer Ss were obtained from freshman mathematics classes of a junior college. The Ss were randomly assigned to three groups (by drawing names from an envelope).

Apparatus and materials

The instructional materials were 50 multiple choice (three-choice) items, prepared so as to be extremely easy to answer. The majority of the items

contained the answer in the item stem, while the rest were "vanishing" items, where the correct answer was contained in the previous item. The subject matter to be taught consisted of the names and the English translations of five symbols commonly used in symbolic logic, and the use of these symbols in translating from symbology to English and from English to symbology. Ten instructional items were prepared for each of the five symbols. The first three items in a set were concerned with the English translation of the symbol; the next three items concerned the name of the symbol; the last four items concerned the use of the symbol.

Five ambiguous items were also prepared, designed to look like legitimate instructional items but containing no correct answer. These five items were intended to contain no information which might either contribute to or detract from the learning of the symbolic logic material; they were used as a vehicle for the presentation of positive or negative reinforcement during the instructional period.

Each item was typed on a 5x8 card, and was shown to S by E through a small window in a wooden screen. The screen was 30 inches high, so that S could not see E over it, but could only see the card in the window. S indicated his choice of answer to each item by pressing a button which turned on a correspondingly-labeled light in front of E. E gave S his knowledge of results by pressing a button which turned on a light in front of S; a green light signaled a correct answer and a red light signaled an incorrect answer. The wooden screens, pushbuttons and lights were the same ones previously used by Coulson & Silberman (1959).

A criterion test, covering the material to be taught, was also constructed. The test contained 45 questions, and was in three parts: Part I (15 questions) required simple recall of the five symbols, their names, and their English translations; Part 2 (12 questions) required translation from symbology to English; Part 3 (18 questions) required translation from English to symbology. Instructions on a cover sheet told S that he was to work rapidly but not rush, that he could change answers, and that he could not return to a part of the test after he had gone on to another part.

Procedure

For Groups I and II, the five ambiguous items were interspersed in the 50 instructional items as follows: one ambiguous item appeared between the sixth and seventh instructional items within each of the five sets. For Group III, the five ambiguous items were placed in the middle of the 50 instructional items, all five ambiguous items appearing consecutively between instructional items 26 and 27. Ss in Group I were signaled that they were correct no matter which choice they gave for the five ambiguous items, while Ss in Groups II and III were signaled that they were incorrect no matter which choice they gave. The design was such that Group I was to receive 55 instances of positive reinforcement, Group II was to receive 50 instances of positive reinforcement and five (spaced) instances of negative reinforcement, and Group III was to receive 50 instances of positive reinforcement and five (massed) instances of negative reinforcement.

In any case where S incorrectly answered an instructional item, E signaled that the answer was correct. This was done so that all Ss would

receive positive reinforcement on all instructional items. In all, 13 Ss answered instructional items incorrectly; all 13 missed the first item, two missed two items and three missed three items. All Ss missing the first item chose the same incorrect answer. No relation was found between missed instructional items and scores on the criterion test.

At the beginning of the experimental session, Ss were instructed on the use of the wooden screen and the signaling buttons and lights. They were told that the experiment was intended to test a series of items to be used in a teaching machine. They were also told they were not being timed during the experiment, and that at the completion of the teaching session they would be given an untimed test to see how well the items taught. The latter instruction also appeared on the cover sheet of the test ("The questions are intended to see if the items in the teaching series actually do teach as well as they are supposed to teach"). Each S then went through the 55 items and immediately began work on the criterion test.

RESULTS

A Kruskal-Wallis one-way analysis of variance by ranks (Seigel, 1956) for total scores on the criterion test indicated a significant difference among the three groups ($H=5.993$, $df=2$, $p=.05$). Comparisons between groups, using the Mann-Whitney U test (Seigel, 1956) yielded results as follows:

1. The groups receiving all positive reinforcement and spaced negative reinforcement did not differ significantly ($U=39$, $df=1$, $.20 > p > .10$).

2. The all positive reinforcement group's scores were significantly greater than those of the massed negative reinforcement group ($\underline{U}$=13, df=1, $p < .01$).
3. The spaced negative reinforcement group's scores were also significantly greater than those of the massed negative reinforcement group ($\underline{U}$=24, df=1, $p=.05$).

An inspection of the tests for Group III was also made. Members of this group not only failed to learn the third symbol, the one in which the massed negative reinforcement was placed, but also failed to learn the preceding and the succeeding symbols.

DISCUSSION

The results of this study support two main conclusions. First, the lack of significant difference between Group I and Group II indicates that the presence of some negative reinforcement within a teaching sequence does not hinder a student's learning. The lack of difference fails to support the position that an all-positive reinforcement teaching sequence is the one best method. Second, the relatively poorer scores on the criterion test for the Ss in Group III demonstrate that a number of negatively reinforcing items, appearing sequentially, will tend to depress a student's learning.

While the date in this study were obtained from a fairly small sample, and while the total teaching sequence was of a short duration, some implications for further teaching machine design are available. One major implication is

that a flexible teaching machine, which uses errors (and negative reinforcement) as a means of identifying a student's difficulty area will not penalize the student by virtue of the presence of the negative reinforcement. A second implication is that any given student must not be allowed to receive too many instances of negative reinforcement one after the other. That is, the decision to show the student easier instructional items must be made before the number of the student's consecutive errors has gotten very large.

References

Ammons, R. B. Effects of knowledge of performance: a survey and tentative theoretical formulation. J. gen. Psychol., 1956, 54, 279-299.

Coulson, J. E. An experimental teaching machine for research at SDC. TM-415, 1 Oct. 1959. System Development Corporation, Santa Monica, California.

Coulson, J. E. and Silberman, H. F. Results of initial experiment in automated teaching. SP-73, 8 July 1959. System Development Corporation, Santa Monica, California.

Gagne, R. M., and Bolles, R. C. A review of factors in learning efficiency. In Galanter, E., Automatic Teaching. New York: John Wiley & Sons, 1959.

MacPherson, S. J., Dees, V., and Grindley, G. C. The effect of knowledge of results on learning and performance. II, III. Quart. J. exp. Psychol., 1948-9, 1, 68-78, 167-174.

Osgood, C. E. Method and theory in experimental psychology. New York: Oxford Univ. Press, 1953.

Seigel, S. Nonparametric statistics for the behavioral sciences. New York: McGraw Hill Book Co., Inc., 1956.

Skinner, B. F. The science of learning and the art of teaching. Harv. Educ. Rev., 1954, 24, 86-97.

Skinner, B. F. Teaching machines. Science, 1958, 128, 969-977.